welcome to the
European Microkelvin Collaboration

CAPACITIES

Report on the Transnational Access Activity carried out within MICROKELVIN

The eligibility of transnational access to a MICROKELVIN TA site implies the submission of the following:

1) The Certification of visit

The form "Certification of visit" must be completed and signed by the access provider in charge of the infrastructure and the leader of the project.

2) A TA project report

The form for the TA project report is contained within this document. It should be completed after project end by the group leader of the project. You must respect the limited number of words specified, longer descriptions will be rejected. Figures/tables may be attached at the end of the document. The document must be submitted in an editable format (doc, rtf).

3) A User group questionnaire

To enable the Commission to evaluate the Research Infrastructures Action, to monitor the individual contracts, and to improve the services provided to the scientific community, each project leader of a user-project supported under an EC Research Infrastructure contract is requested to complete a "user group questionnaire". The questionnaire must be submitted once by each user group to the Commission as soon as the experiments on the infrastructure come to end.

The user group questionnaire is not part of this document and must be completed on-line. It is accessible at:

http://cordis.europa.eu/fp7/capacities/questionnaire_en.html.

► **Please note that any publications resulting from work carried out under the MICROKELVIN TA activity must acknowledge the support of the European Community:**

> **"The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 228464 (MICROKELVIN)."**

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MICROKELVIN Transnational Access Project Report

1. General information

Project number:	AALTO 12A2	
Project Title:	**Microrefrigerator with enhanced cooling power**	
Lead scientist:[1]	Title:	Dr.
	First name:	Jan
	Last name:	Koláček
	Home institution:	Institute of Physics ASCR, Prague
Project scientist:	Title:	Master
	First name:	Michal
	Last name:	Šindler
	Birth date:	26.11.1983
	Passport number:	37790994
	Research status/Position:	researcher
	New User:[2]	yes
	Scientific Field:	superconductivity
	Home institution:	Institute of Physics ASCR, Prague
	Is your home institution MICROKELVIN partner?	☐ Yes ☒ No
	Business address:	Institute of Physics ASCR
	Street:	Cukrovarnická 10
	PO Box:	
	City:	Prague
	Zip/Postal Code:	162 53
	Country:	Czech Republic
	Telephone:	+420 777 583 491
	Fax:	
	E-mail:	Sindler@fzu.cz

[1] The lead scientist indicated here is expected to participate in the campaign as a user of the infrastructure.

[2] Indicate 'Yes' only if the user has never visited the infrastructure before this specific project, otherwise write 'No'.

2. Project information

Please, give a brief description of project objectives: (250 words max)	Quantized charge pumping in superconducting circuits is a research topic which, on one side, deals with geometric phases and adiabatic evolution in quantum mechanics, and, on the other hand, possibly provides future tools in quantum metrology for the realization of the unit ampere. In the proposed project Cooper pairs are transported in fully superconducting circuits with small Josephson junctions by the help of gate voltages and magnetic fluxes. The ultimate goal of the project is to test and hopefully demonstrate the robustness of the adiabatic evolution in quantum Josephson circuits against various noise sources: the adiabatic manipulation would open an alternative way for quantum information processing in superconducting circuits. Recent theoretical efforts yield encouraging predictions in this respect.
Technical description of work performed: (250 words max)	The visitor (Mr. Michal Sindler) took part in the fabrication and performed measurements of Cooper pair pumps ("sluice"), especially with focus on the improvement of the detector sensitivity. 1. The device was realized by means of an on-chip ground plane with the help of an atomic layer deposited (ALD) aluminum oxide film between the shunting structure and the detector junction. Using electron beam lithography and shadow angle evaporation, the Al/AlOx/Al Josephson junction was fabricated on the ALD oxide layers. The escape dynamics in the shunted Josephson junctions was studied experimentally below 0.5 K temperatures. In addition, using the ALD technique, on-chip RF coils in the pumping devices were successfully implemented. 2. The Josephson junction was studied with a shunted resistor mounted on the sample stage. The advantage of this technique is to improve the retrapping process in the junction dynamics, so the detector in the pumping system can respond much more quickly to an input current variation. The structures were fabricated in the MICRONOVA clean rooms and the test experiments were performed in a dilution refrigerator at LTL.
Project achievements (and difficulties encountered):[5] (250 words max)	The main achievement of this project was to improve the detector sensitivity as well as on-chip RF coil performance in the Cooper pair pumping systems. By studying the escape dynamics of the Josephson junctions, it was demonstrated that the technique to add a large shunt capacitance using ALD processing in a Josephson junction is very reliable to prevent the junction from entering phase diffusion. With the help of the ALD technique, coupling of the flux-input into SQUIDs was also enhanced by placing the input coils directly under

	the coils. This is important in order to avoid parasitic coupling in the circuit. Unfortunately, because of the limited time span of the visit at LTL, there was not enough time to apply the techniques to the pumping devices.
Expected publications and dates:	▪ ▪ ▪
Submission date of user group questionnaire:	12 December, 2011 Jan Koláček

Completed Project Reports should be returned to MICROKELVIN Management Office (laitila@neuro.hut.fi, Fax: +358 9 47022969).